presented for scientific training is demonstrated by the large number of students which are always working in the university laboratories, while the expenditure of 30,000*l.* upon the physical laboratory, and 35,000*l.* upon the chemical department, of the New University of Strasburg, serves to illustrate the unsparing hand with which the resources of the country are devoted to the provision of those educational facilities which are the very life-spring of the industrial progress whence those resources are derived.

In France, higher education had been allowed to sink to a low ebb after the provincial universities had been destroyed in the great Revolution, and the University of Paris had been constituted by the first Napoleon the sole seat of high education in the country. Before the late war, matters educational were in a condition very detrimental to the position of the country among nations. There was no lack of educational establishments, but the systems and sequence of instruction lacked organisation, but since the war, France has made great efforts to replace her educational resources upon a proper footing. The provincial colleges have been re-established at a cost of 3,280,000*l.*, and the organisation of industrial education has now been greatly developed, though still not on a footing of equality with that of Germany. Every large manufacturing centre has its educational establishment where technical instruction is provided, with special reference to local requirements; and, in order to render these colleges accessible to the best talent of France, more than 500 scholarships have been founded, at an annual cost of 30,000*l.* The Ecole Centrale des Arts et Manufactures, of Paris, still maintains the reputation as the great technical university of the country which it earned many years ago, and receives students from the provincial colleges, where they have passed through the essential training preliminary to the high technical education which that great institution provides.

Switzerland has often been quoted as a remarkable illustration of the benefits secured to a nation by the thoroughly organised education of its people. Far removed from the ocean, girt by mountains, poor in the mineral resources of industry, she yet has taken one of the highest positions among essentially industrial nations, and has gained victories over countries rich in the possession of the greatest natural advantages. Importing cotton from the United States, she has sent it back in manufactured forms, so as to undersell the products of the American mills. The trade of watch-making, once most important in this metropolis, passed almost entirely to Switzerland years ago; the old-established ribbon trade of Coventry has had practically to succumb before the skilled competition of Switzerland; and although she has no coal of her own, Switzerland is at least as successful as France in her appropriation of the coal-tar colour industry and her rivalry in rate of production with England, the place of its birth and development. Comparative cheapness of labour will not go very far to account for these great successes; they undoubtedly spring mainly from the thoroughly organised combination of scientific with practical education of which the entire people enjoys the inestimable benefit.

Holland furnishes another brilliant example of the success with which a nation brings the power of systematic technical education to bear in securing and maintaining industrial victories in the face of most formidable disadvantages, while the United States of America, so rich in natural resources, have long since realised the immensity of additional advantages to be gained over European nations in the war of industry by a wide diffusion and thorough organisation of technical education. So long as forty years ago the States already possessed several excellent educational institutions established upon the basis of the Continental polytechnic schools, but it was not until about fifteen years later that the country became thoroughly impressed with the great advances achieved by Germany in technical education, and that the subject was made a thoroughly national one. It is now just upon a quarter of a century ago since Congress ordained that each State should provide at least one college, having for its leading objects the diffusion of scientific instruction in its relations to the industry of the country, and decreed that public lands should be granted to the States and Territories providing such colleges. The combined effect of this State action, and of great private munificence, was a remarkably rapid development of scientific and technical education throughout the country; besides some fifty colleges, with eight or nine thousand students, which sprang out of the Land Grant Act for Industrial Education, there are now in the States about 400 other universities and colleges, in a large proportion of which efficient instruction in applied science is provided. To the useful work accomplished within a few years by these and many other highly important educational institutions, which have placed the acquisition of scientific knowledge within the reach of the very humblest, the enormous strides made by the United States in the development of home industries must unquestionably be in the main ascribed.

(*To be continued.*)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—There are only a few alterations and additions to the usual scientific lecture-list to report, as most of the courses are in continuation of those given last term. Prof. Sylvester is to lecture on the theory of numbers; in the Chemical Department, Mr. Wyndham Dunstan lectures on organic chemistry in relation to medicine and physiology; Prof. Prestwich is to have his usual summer geological excursions; Dr. Tylor continues his exposition of the development of arts, as illustrated in the Pitt-Rivers Museum.

The Sibthorpian Professorship of Rural Economy has been filled up by the re-election of Dr. Gilbert. The Radcliffe Travelling Fellowship has been awarded to Mr. W. Overend, B.A., of Balliol. The statutes of the University Commissioners, which limited the competition for most college scholarships to candidates under nineteen, seem to be having an unfortunate, though not unexpected, effect, as several colleges have lately found it impossible to award scientific scholarships, owing to the want of sufficiently qualified candidates.

There is a good deal of strong feeling in the University with regard to the approaching appointment of a Reader in Geography, and the action of the Delegates of the University Fund in transferring a Readership from History to Geography, just after the offer of the Royal Geographical Society for a similar purpose had been refused, is the subject of much unfavourable comment. There is no thought of opposition to the study of geography, even of scientific geography, but history lecturers not unnaturally complain that the only University appointment open to them should be abolished to make a post for a lecturer in another subject.

CAMBRIDGE.—Among the seven courses on chemistry being delivered this term are lectures on gas analysis and on aromatic bodies, by Dr. S. Ruhemann. Prof. Dewar and Dr. Ruhemann also superintend laboratory practice specially directed to research.

The course given by Mr. Lyon, the Superintendent of the Mechanical Workshops, this term is on machine construction.

Mr. Langley is giving a special course on the central nervous system, with demonstrations and practical work.

Prof. Macalister's lectures this term are on the history of human anatomy. It is to be hoped that he will publish them.

Mr. M. A. Fenton is lecturing on elementary comparative osteology: Dr. Gadow on the morphology of Mammalia, recent and extinct, and on the palæontology of the Vertebrata.

Dr. Vines has a course of advanced embryology of plants, and Mr. F. Darwin is giving advanced demonstrations in the physiology of plants.

In geology, Prof. Hughes is taking the geology of the neighbourhood of Cambridge, by lectures and field excursions; Mr. Marr, foreign stratigraphy; and Mr. Roberts, the Trilobites.

Prof. Roy has classes for general pathology, morbid anatomy, and practical morbid histology, bacteriology, &c.

The lectures mentioned above are only a selection of the more interesting courses. The lists from which the above are selected announce about seventy-five courses of lectures and practical work.

Candidates for the John Lucas Walker Studentship, the holder of which must devote himself or herself to original research in pathology, should send their applications to Prof. Roy, Trinity College, Cambridge, not later than May 31 next. The Studentship is of the annual value of 250*l.*, and is tenable under certain conditions for three years.

SCIENTIFIC SERIALS

The American Journal of Science, April.—Contributions to meteorology, twenty-second paper, by Elias Loomis. In this communication the author treats of areas of high pressure, their

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magnitude and direction of movement, and their relation to areas of low pressure. The latter subject is illustrated with a plate giving the isobars for December 15, 1882, in the northern hemisphere, and it is shown generally that the movement of areas of high pressure depends upon very different causes from that of areas of low pressure, which seem to be endowed with a power of locomotion residing within themselves. Areas of high pressure exhibit no such power, their movement seeming to depend entirely on external forces.—The faults of South-West Virginia, by John J. Stevenson. Here is given a summary of the information communicated by the author in several memoirs read before the American Philosophical Society (1880-84) on a reconnaissance made by him of the faulted region in Virginia from the Tennessee line to nearly twenty miles beyond New River, a total distance of 150 miles.—On Taconic rocks and stratigraphy, with a geological map of the Taconic regions, part 2, by James D. Dana. The general facts are here detailed which bear on the geographical distribution of the limestone and other rocks. A description is given of Williamstown, regarded as the birthplace of the Taconic system, and it is shown generally that the great quartzite formation, forming the foundation of the Palæozoic of the region, derived its material from Archæan formations of the vicinity and not from the fabled "Atlantis" as some geologists have supposed.—Irish esker drift, by G. H. Kinahan. It is pointed out that, in common with some other observers, Prof. Carvill Lewis confounds true esker drift and ridges of esker-like drift. His statement in the December number of the *American Journal of Science* that the Irish eskers appear to be adjuncts of the melting of the ice-sheets is shown to be impossible.—Physical characteristics of the northern and north-western lakes, by L. Y. Schermerhorn. The results are given of the lately completed surveys made by the United States of all the great lakes draining through the St. Lawrence to the Atlantic. The total water-area is 95,275, and the total area of the lacustrine basin over 270,000, square miles. The length of shore-line with connecting rivers is about 5400 miles, the extreme depth of Superior 1008 feet, or over 406 below sea-level, the mean annual rainfall of the whole basin 31 inches, the volume of water in the lakes about 6000 cubic miles, and the discharge of Ontario at St. Lawrence River 300,000 cubic feet per second.—Mineralogical notes from the laboratory of Hamilton College, by Albert H. Chester. Specimens are described and analysed of fuchsite, pink celestite, zinkenite, brochantite, pectolite, crystals of barite, scorodite, and bismuthite.—The topography and geology of the Cross Timbers and surrounding regions in Northern Texas, by Robert T. Hill. This wooded zone penetrating in two belts from Indian territory through the surrounding prairie southwards to 32° N. lat., is explained by the detritus of arenaceous strata which occupy well-defined horizons in the geological series, and which have been exposed by the denudation of the overlying strata.—American Jurassic mammals, by Prof. O. C. Marsh. In this paper are described the remains of several hundred individuals which have come to light since the appearance of the author's previous papers on the subject. Although fragmentary, the remains are usually well preserved, comprising the lower jaws, teeth *in situ*, various portions of the skull, vertebræ, and other parts of the skeleton. Placental as well as marsupial mammals occur in the oldest formations, whence the inference that the former do not derive from the latter evolutionally, as is supposed, but that both of these orders descend in independent lines from a common ancestor.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, March 24.—"On the Magnetisation of Iron in Strong Fields." By Prof. J. A. Ewing, University College, Dundee, and William Low.

The behaviour of iron and steel when subjected to very strong magnetising forces is a matter of considerable practical and very great theoretical interest, especially from its bearing on the molecular theory of magnetisation, which assigns an upper limit to the intensity of magnetism that a piece of iron can acquire, and even suggests that the metal may become diamagnetic under the influence of a sufficiently great force. All experiments hitherto made, by magnetising iron in the field of an electric solenoid, have shown that the intensity of magnetism, $\mathfrak{I}$, as well as the induction, $\mathfrak{B}$, is increasing with the highest values actually given to the magnetising force, $\mathfrak{H}$. It is scarcely practicable, however, to produce by the direct action of a magnetising solenoid, a field whose force exceeds a few hundreds of C.G.S. units.

In the space between the pole-pieces of a strong electro-magnet we have a field of force of much greater intensity than it is practicable to produce by the direct action of the electric current. This field is not well adapted for experiments whose object is to determine with precision the relation of magnetisation to magnetising force, on account of the distortion which it undergoes when the piece of iron to be magnetised is introduced into it. It is, however, well suited for experiments whose object is to determine how much magnetism the metal can be forced to take up.

In the authors' experiments, bobbins of Lowmoor and Swedish wrought-iron and cast-iron were magnetised by placing them between the pole-pieces of a large electro-magnet. The bobbins consisted of a short narrow central neck with conical ends. The magnetic induction in the neck was measured ballistically by means of an induction coil, consisting of a single layer of fine wire, wound on the neck; and the magnetic field in the air-space immediately contiguous to the neck was also measured by means of a second induction coil wound over the first, and of slightly greater diameter. This enabled the non-ferrous space under the inner induction coil to be corrected for, and also gave an approximation to the value of $\mathfrak{H}$, the magnetic force acting on the metal. The magnetic force varied up to about 11,000 C.G.S. units, and the highest induction observed (in a sample of Lowmoor wrought-iron) was 32,880 C.G.S. units. In some instances the magnetic induction was observed by withdrawing the bobbin; in others the bobbin was turned round suddenly so that its magnetism was reversed. The following results refer to Lowmoor wrought-iron and to cast-iron.

Lowmoor wrought-iron

Field round iron neck per sq. cm.		Magnetic induction in the metal		Current in field magnets, amperes		$\frac{\mathfrak{B}-\text{outside field}}{4\pi}$		$\frac{\mathfrak{B}}{\text{outside field}}$
3,630	...	24,700	...	1·98	...	1680	...	6·80
6,680	...	27,610	...	4·04	...	1670	..	4·13
7,800	...	28,870	...	5·81	...	1680	...	3·70
8,810	...	29,350	...	7·60	...	1630	...	3·33
9,500	...	30,200	...	11·0	...	1650	...	3·18
9,780	...	30,680	...	13·5	...	1660	...	3·14
10,360	...	30,830	...	16·2	...	1630	...	2·98
10,840	...	31,370	...	21·6	...	1630	...	2·89
11,180	...	31,560	...	26·8	...	1620	...	2·82

Cast-iron

Field round iron neck per sq. cm.		Magnetic induction in the metal		Current in field magnets, amperes		$\frac{\mathfrak{B}-\text{outside field}}{4\pi}$		$\frac{\mathfrak{B}}{\text{outside field}}$
3,900	...	19,660	...	1·97	...	1250	...	5·04
6,400	...	21,930	...	3·75	...	1240	...	3·42
7,710	...	22,830	...	5·38	...	1200	...	2·96
8,080	...	23,520	...	7·08	...	1230	...	2·91
9,210	...	24,580	...	13·15	...	1220	...	2·67
9,700	...	24,900	...	16·9	...	1210	...	2·57
10,610	...	25,600	...	22·6	...	1190	...	2·46

The magnetic force within the metal ($\mathfrak{H}$) differs from the field in the surrounding space by an amount which cannot be estimated without a knowledge of the distribution of free magnetism on the pole-pieces and conical faces of the bobbin. It appears probable that, with the dimensions of the various parts used in these experiments, the magnetic force within the metal is less, but not very greatly less, than the outside and closely neighbouring field. In the absence of any exact knowledge of $\mathfrak{H}$, it is interesting to examine the relation of $\mathfrak{B}$ to the outside field. Thus, ($\mathfrak{B}$ – outside field)/4π gives a quantity which is probably not much less than the intensity of magnetism, $\mathfrak{I}$. The values of this quantity and also of the ratio $\mathfrak{B}$/outside field for Lowmoor wrought-iron and cast-iron are stated in the tables above.

Curves are given showing the relation of $\mathfrak{B}$ to $\mathfrak{B}$/outside field for Lowmoor iron and for cast-iron, in the manner introduced by Rowland for showing the relation of $\mathfrak{B}$ to μ (the permeability). The curves have the same kind of inflection that a curve of μ and $\mathfrak{B}$ begins to have when the magnetising force is raised sufficiently high. The range through which the permeability of iron may vary is well shown by comparing the values

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